MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

ETM7126 – SATTELITE COMMUNICATIONS

5 MARCH 2016
2:30 P.M- 5:30 P.M
(3 Hours)

INSTRUCTION TO STUDENT

1. This examination paper consists of 5 pages including cover page with 4 Questions only.

2. Attempt **ALL** the questions. Each question carry equal marks and distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided. Please number your answers clearly.

Question 1

(a) State Kepler's three laws of planetary motion.

[6 marks]

(b) The following elements apply to a satellite location in an orbit:
Elevation Angle = 5°
Distance from an earth station = 42164 km
Earth's radii = 6378 km
Determine the nadir angle and latitude angle of the satellite location using topocentric co-ordinates.

[5 marks]

(c) In launching of satellite is towards near the east, given the latitude angle of 76.3° and azimuth angle of 95°. Determine the inclination value of the orbit where the satellite will be launched.

[5 marks]

(d) An earth station situated in the Docklands of London, England needs to calculate the look angle to a geostationary satellite above the Indian Ocean operated by Intelsat. The details of the earth station site and the satellite are as follows:

Earth station latitude and longitude are 52.0° and 0°.
Satellite latitude and longitude (subsatellite point) are 0° and 66°.

Find :

(i) Central angle

[3 marks]

(ii) Elevation angle

[2 marks]

(iii) Intermediate angle

[2 marks]

(iv) Azimuth angle

[2 marks]

Continued .....

Question 2

(a) In satellite communication system, an antenna has the following parameters:
Power radiated from antenna = 100 W
Antenna radius = 2 m
Electric flow on the surface = 50 V/m
Impedance = 73 Ω
Find the far field maximum gain of an antenna.

[5 marks]

(b) Find the maximum gain of an antenna that has a diameter of 0.04487m and operating frequency at 6 GHz. Assume that efficiency of antenna is 0.6.

[3 marks]

(c) Describe about the cross polarization and the three types of polarization.

[5 marks]

(d) A satellite circuit has the following parameters as shown in Table Q2. Calculate the overall Carrier to Noise Ratio (C/N_o) value in dBHz.

[5 marks]

Table Q2

	Uplink	Downlink
EIRP	54 dBW	34 dBW
G/T	0 dBK^{-1}	17 dBK^{-1}
FSL	200 dB	198 dB
RFL	2 dB	2 dB
AA	0.5 dB	0.5 dB
AML	0.5 dB	0.5 dB

(e) In a satellite uplink system, given that the transmitted power is 10 watts, and both the transmitter and receiver parabolic antennas have a diameter of 3 m. The antenna efficiency is 55% for both antennas. The satellite is in a geostationary satellite orbit (GSO) location with a range of 35 900 km. The frequency of operation is 12 GHz. Determine the following:

(i) Antenna gain

[2 marks]

(ii) Effective isotropic radiated power (EIRP)

[1 mark]

(iii) Free space loss

[2 marks]

(iv) Received power

[2 marks]

Continued.....

Question 3

(a) Discuss THREE(3) multiple access schemes used in satellite communications system.
[6 marks]

(b) List FIVE(5) main considerations that will affect the sharing a satellite by different earth stations.
[5 marks]

(c) Explain why network synchronization is important in Time Division Multiplex Access (TDMA) system.
[2 marks]

(d) In a Single Channel Per Carrier-Frequency Modulation-Frequency Division Multiple Access (SCPC-FM-FDMA) system, given that the lowest frequency, f_l is 300 Hz and the highest frequency, f_m is 3.4 kHz with a specific channel Signal Noise Ratio, SNR = 33 dB. Let the test tone peak frequency deviation be Δf = 9.1 kHz. Assume no preemphasis de-emphasis and companding. Find:

(i) the bandwidth of the SCPC-FM-FDMA
[3 marks]

(ii) the carrier-to-noise ratio of the SCPC-FM-FDMA.
[3 marks]

(e) Given the information of a satellite that uses the Time Division Multiple Access (TDMA) scheme as in Table Q3, determine the frame efficiency and voice channel capacity.
[6 marks]

Table Q3

Frame length	120000 symbols
Traffic burst/frame	12
Reference bursts/frame	2
Guard interval	102 symbols
Voice channel bit rate	64 kb/s with QPSK modulation
Frame period	2 ms
Header /preamble	280 symbols

Continued .....

Question 4

(a) State THREE (3) characteristics of Iridium satellite constellation.

[6 marks]

(b) Explain the advantages and disadvantages of using multibeam in satellite networking.

[6 marks]

(c) Describe the need of intersatellite links between Geostationary and Low Earth Orbit satellites (GEO-LEO). Draw a diagram to distinguish between GEO and LEO orbit.

[7 marks]

(d) Consider a multibeam satellite system with M spot beams. The total bandwidth B is divided into 4 equal subbands. Subband 1 is used 6 times, subband 2 is used 4 times, subband 3 is used 3 times and subband 4 is used 3 times. Calculate:

(i) the re-use factor if no orthogonal polarisation is used.

[2 marks]

(ii) the re-use factor if orthogonal polarisation is used.

[2 marks]

(iii) Comment on the results obtained above.

[2 marks]

End of Paper